

State-of-the-Art Battery Safety

One of the major needs of battery users is to understand the safety performance of the cells and batteries. We are investigating reactions that generate heat and gas, the two main problems leading to poor abuse tolerance. Chemical composition of gas helps us understand reactions responsible for thermal runaway.

Safety devices within the battery should be designed so that, when the batteries are exposed to extreme conditions (e.g., high temperature or electrical abuse), the battery fails gracefully. Additionally, battery manufacturers are interested in analyzing the composition of the vented materials (mainly gas).



Initial
Vent
of Gas &
Electrolyte



Initial
Thermal
Runaway



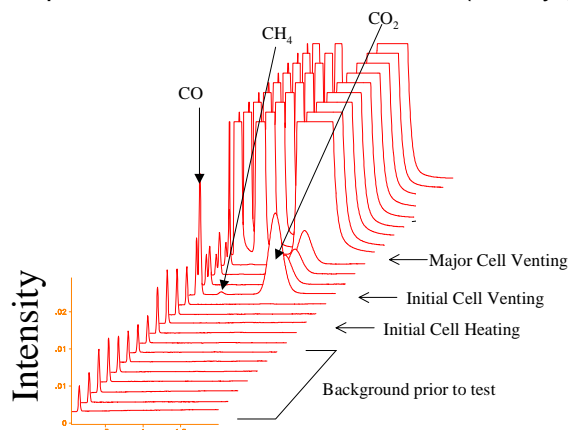
Full
Thermal
Runaway

Thermal Abuse: Heating Cells to 200°C at 80% State Of Charge

We are using a variety of thermal analysis techniques to identify the nature and source of thermal instabilities in batteries under various operational and abusive conditions. The types of studies are:

- Thermal Abuse Furnace Studies
- Accelerating Rate Calorimetry
- Microcalorimetry
- Differential Scanning Calorimetry

Exothermic (heat producing) reactions begin as low as 80°C in lithium-ion cells, but the thermal runaway temperature is generally in excess of 130°C. The low-temperature reactions are influenced by anode chemistry and the higher temperature reactions (>170°C) involve both anode and cathode. The severity of all responses is very dependent on state-of-charge and decreases with age. Mechanisms that lead to heat production have been identified and solutions are being investigated.



Retention Time

GC traces of vent gas analysis during thermal abuse.

We have developed state-of-the-art capabilities to analyze the quantity and identity of gaseous species. Real Time Mass Spectroscopy & Gas Chromatography Gas Analysis have been used to characterize vented gas during abuse. FTIR and other analytical techniques have been also used to analyze "grab samples".

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